

# Osteomyeliti

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**Osteomyelitis** (sometimes abbreviated to OM, and derived from Greek words *osteon*, meaning bone, *myelo* meaning marrow, and *-itis* meaning inflammation) is **infection** and **inflammation** of the **bone** or **bone marrow**.<sup>[1]</sup> It can be usefully subclassified on the basis of the causative organism (**pyogenic** bacteria or **mycobacteria**) and the route, duration and anatomic location of the infection.

## 1 Classification

The definition of OM is broad, and encompasses a wide variety of conditions. Traditionally, the length of time the infection has been present and whether there is **suppuration** (pus formation) or **sclerosis** (increased density of bone) is used to arbitrarily classify OM. Chronic OM is often defined as OM that has been present for more than one month. In reality, there are no distinct subtypes, instead there is a spectrum of pathologic features that reflect balance between the type and severity of the cause of the inflammation, the **immune system** and local and systemic predisposing factors.

- Suppurative osteomyelitis
- Acute suppurative osteomyelitis
- Chronic suppurative osteomyelitis
- Primary (no preceding phase)
- Secondary (follows an acute phase)
- Non-suppurative osteomyelitis • Diffuse sclerosing
- Focal sclerosing (**condensing osteitis**) • Proliferative periostitis (periostitis ossificans, **Garré's sclerosing osteomyelitis**)
- Osteoradionecrosis

OM can also be typed according to the area of the skeleton in which it is present. For example, **osteomyelitis of the jaws** is different in several respects from osteomyelitis present in a **long bone**. **Vertebral osteomyelitis** is another possible presentation.

## 2 Cause

In children, the **long bones** are usually affected. In adults, the vertebrae and the **pelvis** are most commonly affected.

Acute osteomyelitis almost invariably occurs in children. When adults are affected, it may be because of compromised host resistance due to debilitation, **intravenous** drug abuse, infectious root-canaled teeth, or other disease or drugs (e.g., **immunosuppressive** therapy).

Osteomyelitis is a secondary **complication** in 1–3% of patients with pulmonary **tuberculosis**.<sup>[1]</sup> In this case, the bacteria, in general, spread to the bone through the **circulatory system**, first infecting the **synovium** (due to its higher **oxygen** concentration) before spreading to the adjacent bone.<sup>[1]</sup> In tubercular osteomyelitis, the long bones and vertebrae are the ones that tend to be affected.<sup>[1]</sup>

*Staphylococcus aureus* is the organism most commonly isolated from all forms of osteomyelitis.<sup>[1]</sup>

Bloodstream-sourced osteomyelitis is seen most frequently in children, and nearly 90% of cases are caused by *Staphylococcus aureus*. In infants, *S. aureus*, Group B streptococci (most common<sup>[3]</sup>) and *Escherichia coli* are commonly isolated; in children from one to 16 years of age, *S. aureus*, *Streptococcus pyogenes*, and *Haemophilus influenzae* are common. In some subpopulations, including intravenous drug users and splenectomized patients, Gram-negative bacteria, including enteric bacteria, are significant pathogens.<sup>[4]</sup>

The most common form of the disease in adults is caused by injury exposing the bone to local infection. *Staphylococcus aureus* is the most common organism seen in osteomyelitis, seeded from areas of contiguous infection. But anaerobes and Gram-negative organisms, including *Pseudomonas aeruginosa*, *E. coli*, and *Serratia marcescens*, are also common. Mixed infections are the rule rather than the exception.<sup>[4]</sup>

Systemic mycotic (fungal) infections may also cause osteomyelitis. The two most common are *Blastomyces dermatitidis* and *Coccidioides immitis*.

In osteomyelitis involving the vertebral bodies, about half the cases are due to *S. aureus*, and the other half are due to tuberculosis (spread hematogenously from the lungs). Tubercular osteomyelitis of the spine was so common before the initiation of effective antitubercular therapy, it acquired a special name, Pott's disease.

The *Burkholderia cepacia* complex has been implicated in vertebral osteomyelitis in intravenous drug users.<sup>[5]</sup>

### 3 Pathogenesis

In general, microorganisms may infect bone through one or more of three basic methods

- Via the **bloodstream** (*haematogeneously*) - the most common method<sup>[6]</sup>
- Contiguously from local areas of infection (as in **cellulitis**), or
- Penetrating **trauma**, including **iatrogenic** causes such as **joint replacements** or internal fixation of **fractures** or **root-filled teeth**.<sup>[1]</sup>

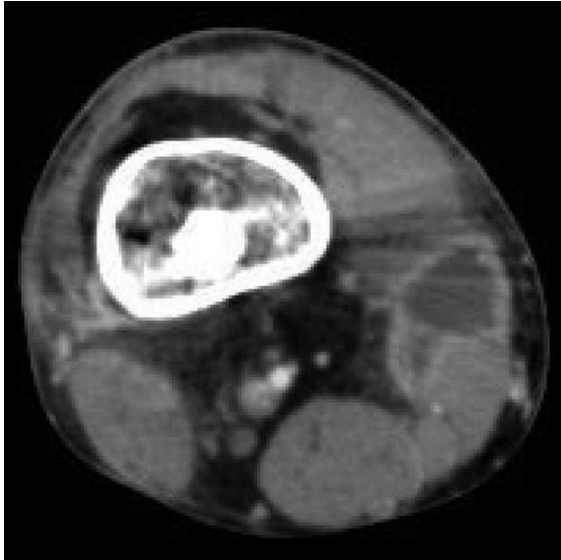
The area usually affected when the infection is contracted through the bloodstream is the **metaphysis** of the bone.<sup>[6]</sup> Once the bone is infected, **leukocytes** enter the infected area, and, in their attempt to **engulf** the infectious organisms, release **enzymes** that **lyse** the bone. **Pus** spreads into the bone's blood vessels, impairing their flow, and areas of devitalized infected bone, known as **sequestra**, form the basis of a chronic infection.<sup>[1]</sup> Often, the body will try to create new bone around the area of **necrosis**. The resulting new bone is often called an **involucrum**.<sup>[1]</sup> On **histologic** examination, these areas of necrotic bone are the basis for distinguishing between **acute** osteomyelitis and **chronic** osteomyelitis. Osteomyelitis is an infective process that encompasses all of the bone (**osseous**) components, including the bone marrow. When it is chronic, it can lead to bone **sclerosis** and deformity.

Chronic osteomyelitis may be due to the presence of intracellular bacteria (inside bone cells).<sup>[7]</sup> Also, once intracellular, the bacteria are able to escape and invade other bone cells.<sup>[8]</sup> At this point, the bacteria may be resistant to some antibiotics.<sup>[9]</sup> These combined facts may explain the chronicity and difficult eradication of this disease, resulting in significant costs and disability, potentially leading to amputation. Intracellular existence of bacteria in osteomyelitis is likely an unrecognized contributing factor to its chronic form.

In infants, the infection can spread to a joint and cause arthritis. In children, large subperiosteal abscesses can form because the periosteum is loosely attached to the surface of the bone.<sup>[1]</sup>

Because of the particulars of their blood supply, the tibia, femur, humerus, vertebra, the maxilla, and the mandibular bodies are especially susceptible to osteomyelitis.<sup>[10]</sup> Abscesses of any bone, however, may be precipitated by trauma to the affected area. Many infections are caused by *Staphylococcus aureus*, a member of the normal flora found on the skin and mucous membranes. In patients with sickle cell disease, the most common causative agent is *Salmonella*, with a relative incidence more than twice that of *S. aureus*.<sup>[2]</sup>

## 4 Diagnosis



*Mycobacterium doricum* osteomyelitis and soft tissue infection. Computed tomography scan of the right lower extremity of a 21-year-old patient, showing abscess formation adjacent to *nonunion* of a right femur fracture.

Diagnosis of osteomyelitis is often based on *radiologic* results showing a *lytic* center with a ring of *sclerosis*.<sup>[1]</sup> *Culture* of material taken from a bone biopsy is needed to identify the specific pathogen; alternative sampling methods such as needle puncture or surface swabs are easier to perform, but do not produce reliable results.<sup>[11]</sup>

Factors that may commonly complicate osteomyelitis are fractures of the bone, *amyloidosis*, *endocarditis*, or *sepsis*.<sup>[1]</sup>

## 5 Treatment

Osteomyelitis often requires prolonged *antibiotic* therapy, with a course lasting a matter of weeks or months. A *PICC line* or *central venous catheter* is often placed for this purpose. Osteomyelitis also may require surgical *debridement*. Severe cases may lead to the loss of a limb. Initial first-line antibiotic choice is determined by the patient's history and regional differences in common infective organisms. A treatment lasting 42 days is practiced in a number of facilities.<sup>[12]</sup> Local and sustained availability of drugs have proven to be more effective in achieving prophylactic and therapeutic outcomes.<sup>[13]</sup>

In 1875, American artist Thomas Eakins depicted a surgical procedure for osteomyelitis at Jefferson Medical College, in a famous oil painting titled *The Gross Clinic*.

Prior to the widespread availability and use of antibiotics, *blow fly larvae* were sometimes *deliberately introduced* to the wounds to feed on the infected material, effectively scouring them clean.<sup>[14][15]</sup>

*Hyperbaric oxygen therapy* has been shown to be a useful *adjunct* to the treatment of *refractory* osteomyelitis.<sup>[16][17]</sup>

Open surgery is needed for chronic osteomyelitis, whereby the involucrum is opened and the sequestrum is removed or sometimes saucerization<sup>[18]</sup> can be done.

## 6 Fossil record

Main article: [Paleopathology](#)

Evidence for osteomyelitis found in the fossil record is studied by [paleopathologists](#), specialists in ancient disease and injury. It has been reported in fossils of the large carnivorous dinosaur *[Allosaurus fragilis](#)*.<sup>[19]</sup>

## 7 See also

Media related to [Osteomyelitis](#) at Wikimedia Commons

- [Brodie abscess](#)
- [Chronic recurrent multifocal osteomyelitis](#)